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Light regime characterization in an airlift photobioreactor for production of microalgae with high starch content

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Biological CO2 fixation and energy production are potential measures expected to mitigate the increase of atmospheric CO2 concentration and to minimize future energy crises. The slow development of microalgal biotechnology stems from the failure in the design of large-scale photobioreactors where light energy is efficiently utilized. Due to the light gradient inside the reactor and depending on the mixing properties, algae are subjected to light/dark cycles where the light period is characterized by a light gradient. These light/dark cycles will determine productivity and biomass yield on light energy. This work reports on the characterization of the light regime in a photobioreactor, based on the airlift principle, that enhances productivity by using the flashing-light effect, determining the time that microalgae spend in the dark and photic zone through the liquid circulation time (10–100 s), which depends on the superficial gas velocity and reactor design (e.g. baffles). The method combines the utilization of particle tracking, signal analysis and optical fiber technology, which altogether give information about temporal and spatial aspects of light patterns. The quality and amount of the light reaching a given point of the photobioreactor were determined and correlated with cell density, light path length and hydrodynamic characteristics of the bioreactor. The importance of this work lays on the fact that it describes the light distribution profile, and therefore the irradiance conditions, more precisely. Moreover, the analysis of the photobioreactor system based on local available light energy presents a valid means of determining the algal cell growth rate.